Designing Scientific Analysis Tools for Collaborative Environments

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Outline for Paper

- Introduction
- Design decisions to achieve collaboration with
  - acceptable latency
  - high resolution dynamic scenes
  - a capability to publish dynamic analyses on the Web
- Demonstration

Outline for Talk

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Introduction

- Most attention has been paid to:
  - Desktop video
  - Audio
  - Whiteboards
  - Chat rooms and MOOs
  - Document sharing
- Also needed for scientific collaboration
  - The scientist's favorite analysis tools

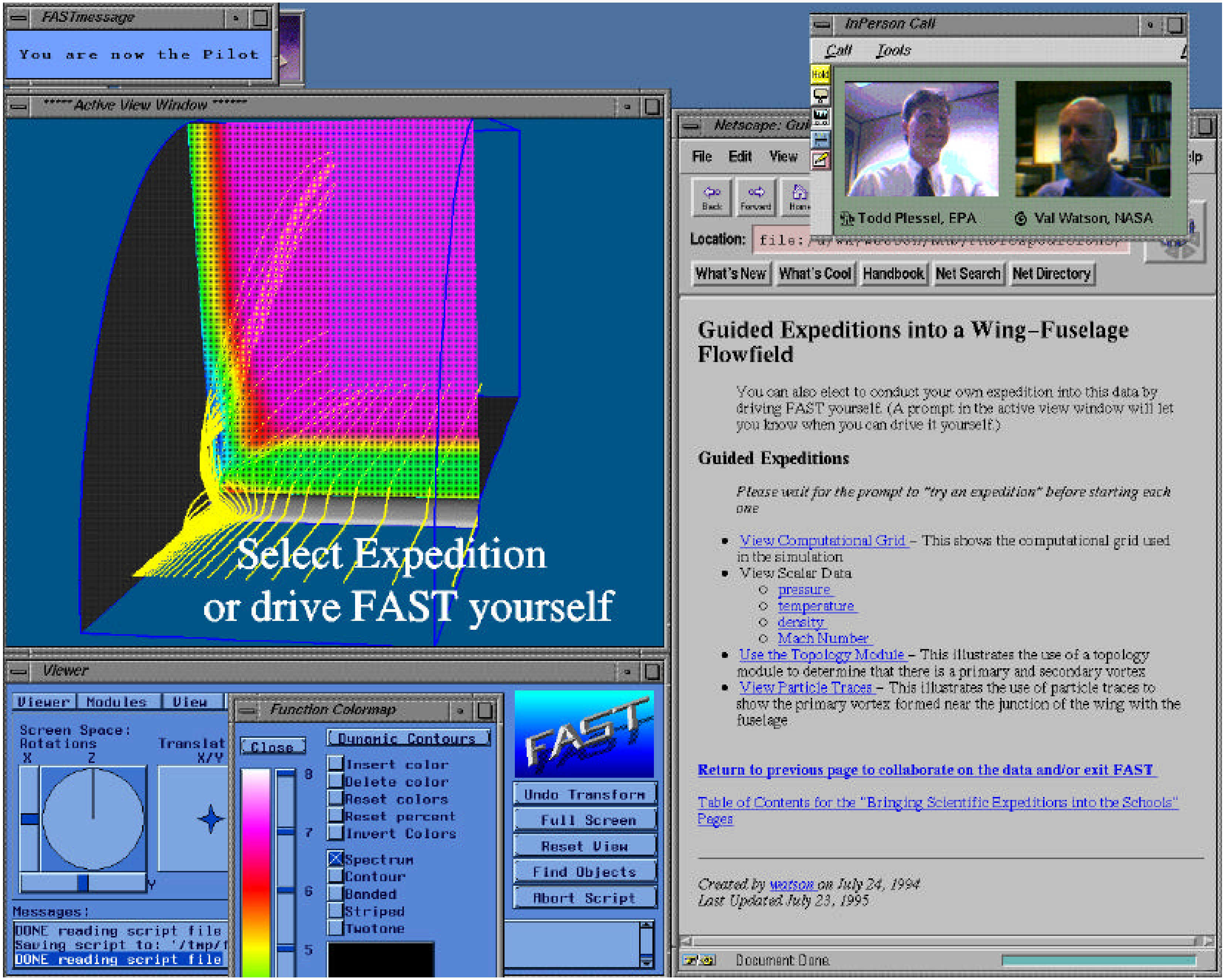
Demonstration

- A scientific visualization tool
  - FAST (Flow Analysis Software Toolkit)
- Modified for asynchronous collaboration
  - Publishing scientific analyses on the web
- Modified for synchronous collaboration
  - Simultaneous remote collaborative visualization

What You Will See in the Demo

- Start with asynchronous collaboration
  - Scientist reviewing a dynamic analyses contained within a scientific report on the Web
- Seamless move to local analysis
  - Scientist continuing with a self-controlled analysis of the same data
- Seamless move to synchronous collaboration
  - Scientist connecting with the author and jointly performing additional analyses

Image of Local Computer Screen while in Remote Collaboration



Demonstration

A very low quality streaming video of the demonstration can be seen at

http://www.nas.nasa.gov/~watson/FASTwww.mov

Summary of Key Features

- Remote collaboration with low latency
- Highly interactive, high resolution, dynamic, 3D graphics
- The capability to publish dynamic analyses on the Web that can be extended locally

Design Decisions for Low Latency

- Use some peer to peer communications.
  - For synchronous collaboration, used dedicated event handling ports serviced by continuously running daemons.
- Use local controls to drive local displays.
  - Used the local keyboard to control a display program running on the local workstation rather than a display program on a server.

Round trip latency to distant sites can be > .1 second

Design Decisions for High Resolution Dynamic Scenes

- Use intelligent compact communications.
  - Concise script commands were sent over the net rather than pixels or drawing primitives.
- Use local rendering.
  - Rendering was done by the local analysis program.

Did not use the "infinite bandwidth" assumption

Why Not Just Send Pixels from a Remote Graphics Server

- Now
  - Typical Internet bandwidth between remote sites $\ll$ bandwidth between the local computer and the human.
- Future
  - Internet bandwidth rapidly increasing (Gilder's Law).
  - But
    - Bandwidth between the local computer and the human is also increasing.
    - We are not close to saturating the human info processing capability.
    - The number of high bandwidth users also increasing.
    - There is a trend toward wireless communications.

Design Decisions for Publishing Dynamic Analysis Sessions on the Web

- Include a journal capability and a capability to drive the analysis tool with a journal file.
  - Used automatically generated journal files
    - Based on a scripting language tailored to FAST
      - Concise
      - Editable (ASCII text)
  - Published sessions consist of data and journal files of analyses.

Conclusions

- Collaborative environments have the potential for a major impact on scientific research.
- Environments should include the scientists' favorite visualization tools.
- Effective collaborative visualization was achieved with
  - Low latency
  - Highly interactive, high resolution, dynamic scenes
  - The capability to publish dynamic analysis sessions on the Web

More information at
http://www.nas.nasa.gov/~watson

Example Segment of an Analysis Script

```
#-----------------------------------------------------
# File written from FAST (Version 1.0.1)
# Module FAST_HUB (Version 1.0.1)
# File created: Fri Feb 19 13:25:44 1993
#
# No user comments should be placed above this header
#-----------------------------------------------------
file_IO: READ_FILE shuttlex.bin
file_IO: FILE_TYPE SOLUTION
file_IO: READ_FILE shuttleq.bin
file_IO: QUIT_MODULE
viewer: MODULE_START Calculator
calculator: S0 = Pressure
calculator: QUIT_MODULE
viewer: OPEN_PANEL COLORS
viewer: COLOR BACKGROUND 0.300000 0.300000 0.300000
viewer: CLOSE_PANEL COLORS
viewer: MODULE_START Surfer
surfer: SLIDER I END 53
```

Example Segment of an Analysis Script

```
#-----------------------------------------------------
# File written from FAST (Version 1.1a----NASA Ames Research Center)
# Module FAST_HUB (Version 1.1a----NASA Ames Research Center)
# File created: Mon Sep 22 16:34:59 1997
#
# No user comments should be placed above this header
#-----------------------------------------------------
viewer: CLOSE_PANEL SCRIPT_FILE_PANEL
viewer: VIEW_FULL_SCREEN
viewer: SET_VIEW GROUP RELATIVE OBJECT_SCALE -0.400000 -0.400000 -0.400000
viewer: SET_VIEW GROUP RELATIVE OBJECT_SCALE -0.400000 -0.400000 -0.400000
viewer: SET_VIEW GROUP RELATIVE OBJECT_SCALE -0.400000 -0.400000 -0.400000
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viewer: SET_VIEW GROUP RELATIVE OBJECT_SCALE -0.400000 -0.400000 -0.400000
viewer: SET_VIEW GROUP RELATIVE SCREEN_TRANSLATE -0.4 0.3 -1.0
viewer: SET_VIEW GROUP RELATIVE SCREEN_TRANSLATE -0.4 0.3 -1.0
viewer: SET_VIEW GROUP RELATIVE SCREEN_TRANSLATE -0.4 0.3 -1.0
viewer: SET_VIEW GROUP RELATIVE OBJECT_TRANSLATE 1.0 0.0 0.0
viewer: SET_VIEW GROUP RELATIVE OBJECT_TRANSLATE 1.0 0.0 0.0
viewer: SET_VIEW GROUP RELATIVE OBJECT_TRANSLATE 0.8 0.0 0.0
```